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The MONTHLY REVIEW

Published Monthly by the

American Electro-Platers Society

A SOCIETY FOR THE ADVANCEMENT
OF THE
SCIENCE OF ELECTROPLATING

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CONTENTS — INDEX Page

Convention Notice 3
Convention News 4
Report of Paul A. Oldan, Dist. 5, Bureau of Education 5
Dubpernell—The Cause of the Adherence of Electrodeposits 9
Hudgins-Cameron—Black Oxidized Finishing 17
Branch News 21
Eldridge—Rapid Nickelplating 21
Elementary Course in Chemical Analysis of Plating Solutions 22
A Letter to All Active Members 28
Low pH Deposition of Nickel 30
Applications, Elections, Suspensions, Resignations, Transfer, Deaths 38

MONTHLY REVIEW

Published by the

American Electro-Platers Society

Publication and Editorial Office

90 Maynard St., Springfield, Mass.

VOL. XIX MARCH, 1932 No. 3

Start now to prepare for the best Convention ever held

by the

AMERICAN ELECTRO-PLATERS SOCIETY

Date: **June 20-23, 1932**

Place: **Philadelphia**

CONVENTION NEWS

The 1932 convention will be held in the Crystal Ball Room of the Benjamin Franklin Hotel in Philadelphia on June 20, 21, 22 and 23, 1932.

Past President Geo. Gehling, 5001 Tulip St., Philadelphia, Pa., has been appointed director of the convention, and the following committees will assist him to make all arrangements and also look after the welfare of all attending the convention:

HOTEL COMMITTEE
OTTO MOTT and ED. HOMAN
4620 Boudinot St., Phila, Pa.

PLANT VISITS
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124 N. Pennock St., Highland Park
Pennsylvania

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327 N. 10th St., Camden, N. J.

BANQUET COMMITTEE
SAM. BARR, *Ch.*
711 N. 19th St., Phila. Pa.

LADIES' ENTERTAINMENT COMMITTEE
J. J. BASCH, *Ch.*
310 Wesley Bldg., Phila., Pa.

MEN'S ENTERTAINMENT COMMITTEE
WARREN REYNOLDS, *Ch.*
807 Hellerman St., Phila., Pa.

The Educational Programme has been divided into three divisions, viz:

TECHNICAL
Papers from Colleges and Technical Societies
DR. HIRAM S. LUKENS, University of Penna., *Ch.*
Harrison Laboratory, 34th and Spruce Sts., Phila., Pa.

INDUSTRIAL
Papers from Industrial and Chemical Plants and Associate Members
DR. A. K. GRAHAM, University of Penna., *Ch.*
Harrison Laboratory, 34th and Spruce Sts., Phila., Pa.

ACTIVE MEMBERS
Reports of the Research Committee and Associate, reports of the Educational Bureau and its district chairman, and Papers from the Active Members of the Society.
SAM. T. LUNBECK, Foreman Plater at the Speakman Mfg. Co., *Ch.*
3304 Washington St., Wilmington, Del.

The committee has decided there will not be any night educational sessions, and the time which has previously been spent in picnics will be devoted to plant visits.

Of course there will be entertainment, but this will be taken care of during the evenings.

Many inquiries have been made about the registration, and the advertising official programme; the registration will be one dollar and we will not have any official programme with advertisements this year.

Our MONTHLY REVIEW will be our *Official Programme.*

Mr. Sam. T. Lunbeck, Ch. of the Active Members' Papers Committee, has a letter in this issue to the active members of our society and which is in line with the preamble of our constitution, but which has for some reason or other been overlooked, and we hope our active members will respond and let's hear from them.

Another thought which would be instructive and interesting could be worked out by each branch submitting a paper compiled by the members of the branch, and called the branch paper, and as all these things just need a start, why not have your branch submit a paper this year?

Plan your vacation now for June in Philadelphia.

REPORT OF PAUL A. OLDAN, DISTRICT 5 BUREAU OF EDUCATION

REPORT FROM BALTIMORE-WASHINGTON CHEMISTRY CLASS

It was decided that the Baltimore-Washington Branch hold one class meeting a month. The purpose of the course is to make the electroplaters more familiar with the terms and principles of chemistry. Such knowledge will assist them to (a) carry on plating operations more understandingly, (b) follow more intelligently the directions for analysis of solutions, (c) read and understand published articles on plating.

The exact subject for each lesson will depend upon the progress made by the class. The subject matter will follow but expand Chapters III and IV in Blum and Hogaboom's Principles of Electroplating and Electroforming.

The principal topics will be:

1. Matter and Energy
2. Chemical Symbols and Calculations
3. Kinds of Chemical Compounds
4. Acids Basis and Indicators
5. Qualitative Analysis
6. Gravimetric Analysis
7. Volumetric Analysis
8. Colorimetric Analysis

The classes will be held in the Chemistry Building at the Bureau of Standards, Washington, D. C., hours from 3:30 to 5:30 p.m. on the following Saturdays: October 3, November 7, December 5, 1931, and January 9, February 6, March 5, April 2 and May 7, 1932. All classes will be instructed by Dr. Wm. Blum, a member of the Baltimore-Washington Branch.

REPORT FROM THE NEW YORK CHEMISTRY CLASS

The New York Branch of the A. E. S. attend a Practical Electroplating Class, instructed by L. C. Pan, at the College of the City of New York. The class is for Foreman Platers who are handicapped in their daily routine of work. The course then is for the purpose that they acquire some educational work for their required needs. Some of the subjects taught are:

1. Theory of electric dissociation, which is the foundation of the whole electroplating science.
2. Faraday's law, which is the basis of all quantitative computation in electroplating.
3. Anode and cathode efficiencies, which affect the plating time and the thickness of deposit.
4. Electrode potentials and polarization, which determine adherence and smoothness of deposit.
5. Conductivity and resistance of plating solutions, which affect the throwing power and bath voltage.
6. Studies in the effect of temperature, current densities and other operating conditions.
7. Hydrogen Ion concentration or pH.
8. Throwing power.
9. Corrosion tests.

In the laboratory the students go over these topics in an experimental way so that they may obtain fundamental principles of these subjects.

REPORT FROM THE NEWARK CHEMISTRY CLASS

The 1930-1931 chemistry class of Newark Branch was held at the Essex County Vocational School, Sussex Ave. and 1st St.,

Newark, N. J., Monday night from 7-10 p.m., instructed by Mr. George Reuter, a Newark Branch member, with an attendance of about 30 members.

This class was divided into two groups, first-year group for those having no previous knowledge of electroplating chemistry and those having attended previous years and having had analysis of plating solutions.

The first-year group was divided into two men to a group. Then taught the use of balance and chemical apparatus, then given lesson sheets on which are printed in detail all instructions in the making of standard solutions, and the method of analysis of some electroplating solution, starting with the silver solution.

The advanced class reviewed the analysis of the preceding year, and then instructions sheets were given to two-men groups for such solutions as acid copper, cadmium, gold and chromium.

The outlook for the 1931-1932 class is exceedingly bright, with an enrollment of 35.

The first-year class of 1931-1932 will not advance as rapidly in the analysis of solutions, but will first make a silver solution of a definite metal and cyanide content, after which additions of carbonates and brighteners will be added, and noting the effect on solution as well as the structure of the deposit, then making analysis of such solution at different intervals.

The advanced class will again start with the coloring of metals, taking the green color, or verd, first, using all green formulas.

REPORT FROM THE PHILADELPHIA CHEMISTRY CLASS

Philadelphia Branch's class is sponsored by the Philadelphia Board of Education and meets two evenings per week, for 24 weeks, at the Jules Mastbaum Vocational School, Philadelphia, Pa. The teacher is Albert Hirsch, a member of Philadelphia Branch, A. E. S.

It is the only class of Trade Extension in the school that has had 100% attendance 1931-1932. The class is divided into two parts, advanced and elementary classes. In the advanced class we have Foreman Platers who have completed one or more years' work. The elementary class consists of non-members of the A. E. S. working in plating rooms and interested in Trade Extension work.

Subjects taught in the elementary class:

1. An introduction to elementary chemistry, including the use and care of apparatus for volumetric analysis.

2. The composition and preparation of plating baths from formula.

3. A critical study of the principles of electrodeposition of various metals and alloys.

4. Physical and chemical methods of control, including simplified methods of analysis and preparation of standard reagents.

Advanced subjects:

In the second and third years the analysis of plating solutions is taught. Each solution is treated separately and completely before another is started. An average of three different solutions have been covered each year. This year silver, gold and brass solutions have been taken up.

The Elementary Course in Chemical Analysis as prepared by the Bureau of Education is used in this work.

NEWARK BRANCH

Educational Session and Banquet

SATURDAY, APRIL 2nd, 1932

at the

Newark Elks' Club, 1048 Broad Street

Newark, N. J.

Supreme President Philip Sievering will preside at the Educational Session, which will start promptly at 2.30 p.m.

THE CAUSE OF THE ADHERENCE OF ELECTRODEPOSITS

By G. Dubpernell, Chemist, Udylite Process Co.

(A paper read at a meeting of the Detroit Branch, American Electro-Platers Society, January 8, 1932)

Perhaps the earliest theory of the adherence of electrodeposits was that the deposit had to alloy with the basis metal in order to adhere to it. From this point of view non-adherence would be caused by any separating film as of grease, dirt or scale, which separated the basis metal and the deposit and kept them from alloying. Likewise, metals which had little or no tendency to alloying were considered incapable of adhering to each other directly. Thus many years ago it was considered impossible to deposit nickel directly upon iron, zinc and lead because these metals do not readily alloy with each other, and the common practice was to flash these metals with copper before nickelplating The idea behind this was that the copper alloyed readily with both the iron, zinc and lead basis metals and the nickel deposits, and thus acted as a cement between deposit and basis metal. We have since discovered that with proper preparation of the basis metal, best results can be obtained by depositing nickel direct upon iron and zinc, and perhaps this is true of lead also, or may be found to be true in the future.

One reason why this alloying theory of adherence developed into such definitely accepted form in the early days was that a number of cases of absorption of the deposit by the basis metal were observed. As early as 1873 Raoult noticed that cadmium, zinc and tin deposits on gold were absorbed by the gold basis metal. Other cases of the diffusion of deposits into the basis metal which have been frequently observed are gold and silver into lead, and copper, brass, gold and silver into zinc. I have personally observed the absorption of thin silver plate by an undercoating of cadmium, which might be considered the basis metal in this case.

A common case of alloying to promote adherence is the amalgamating or "quicking" of the German silver basis metal preparatory to silverplating. Here the mercury diffuses rapidly through both the basis metal and the deposit, and thus improves adherence. If it is desired to prevent the diffusion of the deposit into the basis metal or of one deposit into another, this can readily be accomplished by interposing a thin layer of nickel. The nickel does not

diffuse into other metals at room temperature and prevents other metals from diffusing through it and into each other.

The fallacy of the above described alloying theory of adherence is obvious when we stop to consider the numerous cases where very good adhesion is obtained without any detectable alloying. Likewise it would not account for the difficulty in securing adherence of nickel deposits upon nickel and of iron upon iron, nor the tendency of these deposits to lamination and splitting up of the deposit itself. This would amount to saying that nickel does not readily alloy with nickel, nor iron with iron.

You are, no doubt, all familiar with the famous Johansson gage blocks which are made so accurately plane and flat that by merely wringing or pressing them tightly together they can be made to adhere to each other so strongly that a tremendous force is required to pull them apart, in spite of the fact that they consist of nothing but two pieces of metal in close contact with each other. Any two solid objects tend to adhere if they have corresponding surfaces and can be brought into sufficiently close contact with each other. The adherence is promoted if there is a thin layer of any liquid which wets the surfaces, between them. Thus, two pieces of glass wet with water are quite difficult to pull apart when placed together.

The force which holds together the separate particles or molecules of a solid material such as a piece of metal is called the force of cohesion. If it were not for this force, the metal would be weak and might fall apart as dust. A strong metal such as iron has high cohesive forces holding its molecules together. It is this same force of cohesion which causes two pieces of metal to adhere when their surfaces are brought into sufficiently close contact with each other. The molecules on the surface of one piece of metal are attracted to the molecules opposite them on the surface of the other piece of metal, and as a result of this attraction the two pieces of metal are held together. Thus, while cohesion is primarily the force of attraction between the molecules of a solid body which resists its being pulled to pieces, adhesion is the sticking of one body to another which is brought about by the coming into play of the forces of cohesion between the molecules on the surfaces of the bodies acting across the interface between them.

What is perhaps the same thing is seen on a much larger scale in connection with the force of gravitation. We, our automobiles,

houses, etc., and everything on the face of the earth, are all kept from falling away into space by an attractive force called gravitation. If we went a few hundred or a thousand miles from the earth's surface, the force of gravity would be very considerably reduced. We can be duly grateful that our adherence to the earth and our distance from it do not vary as greatly as the adherence of electrodeposits to the basis metal, and no doubt in many cases, also, their distance from the basis metal!

Thus the adhesion of one metal to another is specific in nature, and no metal could adhere to another with a force greater than its own tensile strength, as it would rupture in itself as soon as such a force was applied. In this way it can be seen that it is possible to make a stronger joint between strong metals than between weak ones, just as soft soldering does not give as strong a joint as brazing or welding. On this basis it would not seem wise to use an underlay of a soft relatively weak metal such as tin, lead, zinc, or cadmium. On the other hand, if a high degree of adherence is obtained, the result is sufficiently strong for all practical purposes. It is a very rare usage that would require the deposit to withstand forces exceeding the mechanical strength of these metals.

Another theory which has been proposed to explain the adherence of electrodeposits is that this is of a mechanical nature and due to "hooking" or interlocking of the basis metal and deposit. This explanation is advanced especially in connection with the adherence of deposits on aluminum. In this case it always seems to be necessary to secure a certain amount of roughening of the basis metal before any noteworthy adherence is obtained, either by severe etching of the aluminum or by mechanical treatment such as sand blasting. However, it hardly seems as if any very high degree of adherence could be obtained by mere interlocking of the basis metal and deposit, and it would appear more reasonable to assume that the preparatory treatment which roughened the surface prior to plating made it cleaner and "opened out" the surface so that it had a much larger surface area, and the forces of adhesion could better come into play and could take place over a larger area and thus have a much greater total value.

In some cases the forces which the basis metal exerts on the deposit are so great and so little interfered with that the deposit forms as a continuation of the basis metal and there is no dividing line between them. This would be considered 100% perfect ad-

herence. The crystals of the basis metal grow and the same crystal of metal forms part of both the basis metal and the deposit. This is especially true of copper which is etched with nitric acid or bright dipped and then copperplated in the acid bath.

PART II

The Cause of the Non-Adherence of Electrodeposits

While this might perhaps be considered to be the reverse of the above, there are a number of matters which can be better considered under this heading. The main causes for non-adherence can be discussed in three groups.

1. Those due to poor cleaning.
2. Those due to properties of the basis metal.
3. Those due to properties of the plating bath.

By far the largest amount of non-adherence is due to what may be called poor cleaning. It has been said that "dirt" is "matter in the wrong place," and this is especially true in electroplating work. Anything on the surface which may separate the basis metal and the deposited metal and cause non-adherence is to be considered "dirt" and must be removed in the cleaning or preparation of the basis metal for plating. "Dirt" may be solid, liquid or gaseous. Oxide or scale formed from the metal itself is the most common solid present, but all varieties of foreign matter may be encountered. Oxide or scale is removed largely by pickling in acids. Some form of mechanical treatment is frequently desirable, or necessary, to remove solids from the surface. This may take the form of grinding or polishing, tumbling or ball burnishing, sand blasting, hand scrubbing, electric pickling or cleaning, or combinations of these.

Liquid dirt is generally some form of grease or oil, and is usually removed first to as great an extent as possible because it usually impregnates the solid dirt and prevents the pickling acid from acting upon the latter where this is possible. The methods used to remove grease and oil are to immerse in solvents or solvent vapors, and in alkaline cleaning solutions. The latter are almost invariably used in preparation for plating, while solvent or solvent vapor treatments are only occasionally used in addition in order

to remove the excess grease before using the alkaline cleaner or acid pickling to remove the final traces of grease. While acid pickles do not act directly upon grease and oil, they are quite efficient in removing very slight traces of these in a mechanical way due to the gas evolution or because they dissolve the metal away from behind the grease and thus detach it. Nitric acid and bright dipping are especially effective in this way and perhaps also bring about good adherence because they dissolve a surface layer of metal and sweep away anything on it, and, in addition, are very free rinsing and do not tend to cling to the surface.

This brings us to another variety of what might be called "liquid dirt," namely, any solution which clings to, or is absorbed by, the surface and is difficult to rinse off. Thus a deposit frequently will not adhere to an otherwise clean metal surface which has been dipped in an alkaline solution, such as a cleaner, and then rinsed and plated. This is especially true of nickelplating. Perhaps the absorbed alkali oxidizes the surface very slightly, or it may be that a very light film of nickel hydroxide forms on the surface over which nickel deposits without adhering very well. In general, alkalies are difficult to rinse off, while most acids are readily removed. Some cleaners are much more "free rinsing" than others. We have all noticed that if we dip our fingers into a cleaner and then try to rinse them off, a slippery feeling persists between them for a long time, even after repeated rinsing.

Similar results are obtained if a part is dipped in a chromate solution or a chromium-plating bath prior to plating. Chromates and chromic acid are very difficult to rinse off of a surface, but it may also be that a thin, invisible layer of some insoluble compound is formed on the surface which causes the non-adherence.

Gaseous "dirt" is perhaps a new expression to most of us, and yet no good plater will attempt to plate an article dry. It may be that non-adherence is caused in this case by an absorbed film of air which is not dissolved in the solution before the deposit forms over it. I would incline to the view that any oxidation of foreign matter on the surface due to exposure to the air, or picked up while the object is passing through the surface of the plating bath and into it, would be the main cause of non-adherence. It would seem as if the small amount of air on the surface after it was in the bath would quickly dissolve in the solution. Whatever the cause of non-adherence may be in this case, it is essential to always enter the

plating bath with the surface to be plated both perfectly clean and wet with clean water, in order to secure good adherence.

Non-adherence may also be caused by the properties of the basis metal. Thus magnesium has never been successfully plated in aqueous baths because it reacts so vigorously and dissolves in almost any solution. While the deposit is being formed, the magnesium is dissolving out from underneath and the deposit is thus undermined. Similarly aluminum is difficult to plate and perhaps the very highest degree of adherence is never obtained on this metal. Zinc is also an active metal of this nature and it is necessary to use a special nickel solution to plate it. Likewise iron cannot be plated directly in the ordinary acid copper bath and many metals cannot be plated directly with silver.

It is well known that it is quite difficult to deposit a new layer of nickel over an old one, due to the slight film of oxide on the surface of the old nickel. If this nickel can be properly cleaned and the oxide layer removed or reduced and the metal made active again, a further layer of nickel can then be deposited with perfect adherence, because, as a matter of fact, the old nickel is thus brought back to its original condition which it had when it was being deposited, and it is just the same as if the current had only been interrupted for a few seconds. This can be accomplished by cathodic electric pickling of the nickel in hydrochloric acid.

Similar difficulties are had in depositing chromium or other metals upon chromium or chromium alloys, and the remedy is the same. Metals, such as iron, chromium and nickel, readily become passive, even to some extent simply on exposure to the air. While this is not the whole story, for practical purposes we may consider that the passivity of these metals is due to a film of oxide on their surface, and that this is what causes the non-adherence which is encountered. Any treatment which removes this oxide layer and activates the metal will serve to prepare it to receive an adherent plating. Cathodic pickling in hydrochloric acid is perhaps the best method of doing this and, in some cases we have studied, seemed to be the only method we could find. In preparing pure chromium for plating strong hydrochloric acid is best, especially if the acid is used alone. In the latter event, care must be taken that the chromium is dissolving vigorously in the acid, as this is what indicates that the chromium has become active and is ready to receive a further deposit. If cathodic electric pickling is used, a

concentration of 10 to 20% of hydrochloric acid by volume is generally sufficient.

The properties of the plating solution may also have a great deal to do with the adhesion of the deposit. Thus in many cases where difficulties with adherence have been had, it has been customary to flash with cyanide copper or brass plate to secure better adherence. The reason for this is that solutions of this type which evolve some hydrogen during plating and contain some free cyanide and thus free alkali, and are generally operated warm, have a quite appreciable cleaning action before plating, and thus give a very adherent deposit even when the cleaning before plating is not perfect. Solutions low in metal and high in free cyanide and frequently containing cleaner in addition are also used as combination cleaning and plating solutions as the final step in the cleaning procedure and to give a flash deposit which is very adherent.

The composition of the plating solution may also influence adherence directly. Thus deposits of chromium from chloride solutions show extremely poor adherence and it has been found that manganese deposits from sulfate solutions are much more adherent than from chloride solutions. Likewise, we encountered a case at one time where the peeling of the nickel deposit seemed to be due to an excessively high chloride concentration. In these cases it would seem likely that the non-adherence is caused by the formation of a thin layer of some chemical compound on the surface of the basis metal before the deposit begins to form.

The composition of the solution and the temperature and current density used control the mechanical properties of the deposit and these in turn may have a great deal to do with the adherence. Thus nickel deposits may be hard and brittle or soft and ductile, according to the conditions of deposition. With equal degrees of adherence, the hard, brittle deposit will be the first to crack open and peel off. A soft, thick, strong nickel deposit may give every appearance of adherence even though it is not really adherent, especially if it forms a complete wrapping or surrounding envelope about an article and thus reënforces itself. Deposits of this sort are quite commonly used over buffed copper nowadays and while their adherence to the copper is generally not of the highest order, their good mechanical properties enable them to withstand the slight additional strain of a thin chromium deposit, whereas they would

most likely peel if a thick chromium deposit were used. It should be possible to work out a good test for adhesion along this line, as the conditions of chromium deposition can easily be standardized to a high degree, and the strain which a chromium deposit exerts upon the deposits underneath it is roughly proportional to the thickness of the chromium.

The fact that hard, bright, brittle deposits are not necessarily non-adherent is aptly demonstrated by chromium. When chromium is deposited under bright plating conditions, it is so hard and has such high internal stress that the deposit cracks open in innumerable, almost invisible cracks at a thickness of from about .00002" on, without coming loose from the basis metal, just as the mud in a mud puddle cracks open when it drys. This is due to the excessive lateral stress in the deposit compared to the extremely low transverse strength at these thicknesses, and similar phenomena have sometimes been observed in nickel, iron and platinum deposits. As the chromium deposits grow thicker, these cracks become plated over with the further deposit and new cracks form and are plated over in turn. Ultimately the cracking seems to stop entirely, and at any point the net result is a good, strong, wear-resistant deposit. The remarkable thing is that the deposits adhere so well as to resist perfectly the very considerable mechanical strains involved. Their adherence is brought about by a combined cleaning and plating action similar to that of cyanide copper solutions. The warm chromic acid bath is a powerful oxidizing agent and has a considerable cleaning action by itself, which is aided by the electric cleaning action of the vigorous hydrogen evolution.

It is sometimes claimed that a high degree of adherence cannot be obtained on smooth, highly polished surfaces, but the incorrectness of this contention is obvious from the example of Johansson gage blocks above, and the deposition of chromium on bright surfaces.

Another case is occasionally encountered where non-adherence is claimed to be due to the absorption of an undercoat by the basis metal. A moment's reflection should indicate the incorrectness of this idea, as where there are no separating layers between the different deposits, there should not be any produced by alloying. One would rather expect the opposite. What probably happens in these cases where non-adherence appears with time is that corrosion probably takes place at the interface where non-adherence occurs,

either due to external corroding influences or to internal ones, such as corrosive plating solutions held in the pores of the metal or in the deposits; and the corrosion loosens the overlying deposit.

Another common idea which is probably incorrect is that metals with widely different coefficients of expansion will not adhere to each other and will flake off upon alternate heating and cooling. While there is a tendency to do this, the forces of adhesion are so much greater than the forces of tension and compression created by differences in coefficient of expansion that the latter can be readily absorbed by the relatively thin electrodeposit. Where real adhesion is obtained, it is much easier for the deposit to stretch a little or to be compressed somewhat, than it is for it to flake off or to blister.

By way of conclusion I might reiterate that the fundamental cause of adhesion appears to be the cohesive force of attraction between the innermost atoms or molecules of the deposit and the outer ones of the basis metal, and that the closer these can be brought together and the less space or foreign matter separating them, the greater the adherence will be. If the distance between these atoms or molecules is brought down to atomic or molecular dimensions, adhesion equal to the tensile strength of the weaker of the two metals present can be obtained.

BLACK OXIDIZED FINISHING

By L. C. Hudgins and H. A. Cameron

Read at Rochester 1931 Convention

MR. H. A. CAMERON: The commonly known black oxidized finishes have been used for a very long time for the production of a variety of black finishes and for a much larger number of finishes that are not black. The term "black" is therefore somewhat misleading to the layman, but perfectly understood by the plater.

The processes and solutions involved are apparently very simple, but judging by the literature, or rather lack of literature on the subject, we still hesitate to write about the apparently simple things. After considerable study, we have come to the conclusion that this simplicity is decidedly more apparent than real.

What is the proper ratio of ammonia to basic copper carbonate in the ordinary black oxidizing bath for brass? What is the nature

of the deposited film? What part does the brass or the zinc in the brass play in the reaction? If the film formed is deposited from the solution, why will it not deposit on pure copper, on silver, or nickel, or on chromium? The fact that there is no deposit or discoloration of these metals is well known, and it is very fortunate that this is true, because a variety of very beautiful finishes are dependent on this behavior. If we knew the exact composition of the film formed, it unquestionably would be a great help in selecting the right ratio of ammonia to basic copper carbonate, and in fixing the other conditions involved.

Kellner and Curtis (Journal of Industrial and Engineering Chemistry, Volume 22, No. 12, 1930) attempt to answer some of these questions. They state that the basic copper carbonate does not dissolve as such, but is decomposed, the carbonate and some of the hydroxide going into solution with formation of a complex copper ammonium salt. They also state that the best evidence is that the black deposit is a partially hydrated cupric oxide, that the brass is deeply etched, and that zinc appears in the oxidizing solution.

The term "Black Oxidized Finishes" is very broad, but we will consider two only: 1, those produced in the ammonia basic copper carbonate bath, and 2, those produced in the sulphide of soda or potash bath. As stated in the beginning, these finishes are not necessarily black and very often, to our sorrow, are anything but black. The same solution will give a variety of colors, sometimes depending on time of immersion, sometimes on temperature, sometimes on slight variations in composition of bath, and very often on causes that make us age rapidly.

The first two factors are fully controllable; the composition of bath is apt to be variable; and the fourth is just one of those things that we hate but do not know what to do about it.

For our purposes, we designate the ammonia basic copper carbonate black, Brass Black Oxidize, and the sodium or potassium sulphide black, Copper Black Oxidize.

For brass black oxidize, we use a bath of this composition:

Two lbs. of basic carbonate of copper is dissolved in 4 gallons of 26° Bé. ammonium hydroxide and diluted to 12 gallons with water. This quantity of basic carbonate of copper is considerably less than that generally used, but we have found it extremely satis-

factory for general use. The class of work going through this bath consists of ground or scoured dials and scales, etched scales, name plates, and bright dipped brass.

The bath is run cold with vigorous air agitation, and when a dense jet black is required, the parts are immersed for two minutes, rinsed in cold and hot water, and again immersed for two minutes. This gives a very hard, jet black which will stand certain forming operations without any cracking or chipping of the deposit.

Best results are obtained on ground, scoured or sand-blasted surfaces. Etched brass also takes a good finish, but a bright dipped surface is usually unsatisfactory when a uniform color is required. The failure of a bright dipped surface to give entirely satisfactory results is probably due to too high a percentage of copper on the surface. It is fairly well established that when brass is bright dipped there is sometimes a deposit of copper from the bright dip solution.

As previously stated, a large number of colors may be produced in this brass oxidize solution. They run from light browns, through reddish browns, brownish or reddish blacks, jet blacks to blue blacks. We frequently run into reddish blacks or blue blacks when jet blacks are required. This is one of the hard things to control and is due to variations in the bath composition. A chemical analysis is required to determine the composition and as this is somewhat lengthy, we have to rely on experience in making additions to the bath. This is a good opportunity to note that this bath, like others in a plating room, is very much easier to control and keep in first condition when worked to the limit than when on a part-time schedule. Foreman platers, we believe, should emphasize this point, when they are critized for too much non-production time. When our baths are being worked to capacity for jet black finish, we make specified additions four times a day, and get one hundred per cent production.

A variety of very tasteful effects may be secured by first oxidizing to the desired shade and then relieving. This is especially true of rough or irregular surfaces. Some parts are on exhibition in the exhibit room and show the variations that may be produced from a simple brass black oxidizing bath. The colors obtained on these samples were controlled by length of immersion. There was no change in composition of bath. The scale with cream back-

ground and black figures, lines, etc., is particularly interesting. The brass was resisted, etched, sprayed with cream lacquer, resist removed, black oxidized and colorless laçquered in the flat. It was then formed.

Name plates are made in a variety of ways. To produce a black background and silver or chromium letters, etc., we silver or chromium plate, resist, etch and black oxidize. The procedure may be reversed, that is, resist, etch, silver and black oxidize. This latter procedure is not applicable to chromium as we have found no resist that will withstand the chromium bath.

For high-grade scales and dials, our procedure is as follows: Engrave, silverplate, black brass oxidize. This of course is a rather expensive process, but from requirements peculiar to the thermometer industry, etching has not been found practicable.

The copper Black Oxidize bath is made by dissolving 2 oz. of potassium sulphide in one gallon of water. The solution is usually used at about 80° F. and when exhausted discarded and a new solution made. It is used for coloring copper only, and when the base metal is some other material, it must be first copperplated. A cyanide copperplate is sufficient. The part to be oxidized is immersed in the solution until the desired shade is reached, then dried and given any after-treatment desired. Very attractive results are secured by scratch brushing the oxidized part or by scratch brushing and relieving on a felt wheel.

A greater assortment of colors may be secured from this solution than from the brass black oxidize solution, and if the base metal is not brass, of course this solution must be used. The deposit, however, is in general not as hard as the brass black oxidize deposit and very frequently causes the lacquer to peel.

We have made no attempt to go into details regarding these finishes, our chief aim being to call attention to these very old processes with the hope that they may be studied. We electrodeposited copper, nickel and silver for a great many years without knowing much about what we were doing. It is only very recently that some of the mysteries have been cleared away. They were cleared away only as the result of much investigation. We hope that some of the mysteries surrounding the general subject of oxidized finishes will likewise succumb to investigations by all of us interested in electroplating.

BRANCH NEWS

DETROIT BRANCH

The February meeting of Detroit Branch was one of unusual interest, first because of Mr. Charles H. Eldridge's very interesting paper and the highly instructive discussion that followed it, and because of the splendid attendance. We were happy to see so many of our members present, as it proves that the right spirit prevails and that our old Branch is very much alive. Mr. William M. Phillips, our instructor of former days, honored us with his presence and Mr. W. W. McCord let his bowling club to get along as best it could to answer rollcall, and Mr. Wilson and Mr. Lattimer came all the way from Flint to attend. The cigars were presented by Mr. Nankervis and Mr. Bourc and we are promised another smoke for our next meeting.

RAPID NICKELPLATING

A COMPARISON OF PRESENT-DAY PRACTICE IN THE UNITED STATES AND IN EUROPE

By C. H. Eldridge

Within the last two or three years we have heard a great deal about high speed or rapid nickelplating. Being much interested in the subject due to my contacts with platers in general, I took it upon myself to gather together information from all possible sources. The following comments are the result.

In starting out let it be understood that the discussion presented below is not based on the writer's original work or on operations under his supervision, but from a comparison of experiences with local platers, research laboratories, and from the publications of The American Electro-Platers Society, The Electrochemical Society, The Electroplaters' and Depositers' Society of England, and from the technical press here and abroad.

Now, right at the start let me remove one common misconception. Rapid nickelplating is not necessarily high acidity or low pH plating. On the contrary, we find as we go on that low pH is not in use abroad for rapid plating, and that even in the U. S. there is a division of opinion as to the advantages of low pH over high pH. Our Mr. Wm. Phillips is, as we all know, the foremost champion of low pH solutions in the United States, but we must not forget that a nickel solution, skillfully run at pH 5-6.0, will plate equally as fast as a low pH solution and, if anything, be more trouble free.

The development of rapid nickelplating is comparatively recent. The cause of such development was twofold. On one hand

ELEMENTARY COURSE

in Chemical Analysis of Plating Solutions

IN ORDER to familiarize the membership with the work of the Bureau of Education we are sending each Branch a copy of the "Elementary Course in Chemical Analysis of Plating Solutions." The object of the course is to devise a "Definite Plan" for the conductance of Classes for Platers by Branches that do not have classes. The booklet contains directions for sampling, use and care of apparatus, preparation of standard reagents, analysis of nickel, cyanide copper and chromium solutions.

One hundred copies of the booklet have been mimeographed. Each Branch and district chairman will receive a copy free. The balance, or approximately seventy copies, are to be sold at one dollar each.

Should conditions warrant, additional copies will be mimeographed. All copies over the first hundred will net about 40% profit, which will be donated to the Research Fund. Copies of the booklet can be secured through your branch secretary, or by writing to Albert Hirsch, 1945 W. Airdrie St., Philadelphia, Pa.

Remember, when you purchase this booklet you are helping the Research Fund

was the desire to increase the output of the plating room without increasing tank equipment; on the other hand was the demand for heavier and heavier nickel deposits to withstand corrosion. The plater was thus faced with the necessity of speeding up his process or of tying up his equipment for several hours per tank load.

We will now describe briefly, and in turn, rapid nickelplating as practiced in France, in England and in the United States. In Germany and Italy the platers prefer to keep the current density in a lower range, such as is still general practice in the United States.

French Practice

Let me give due acknowledgment here to Dr. Marcel Ballay, Chief of Research, Bureau of Nickel Information, Paris, France. Dr. Ballay's article entitled, "Modern Methods of Nickel Plating," in the April, 1930, issue of the "Revue de Nickel," is the source of my information on the scientific aspects of French plating process. For details of plants and equipments the speaker is indebted to a paper entitled "American and Continental Practice in Nickel Deposition," presented by Mr. W. T. Griffith, of the Mond Nickel Co., Ltd., before the Electroplaters' and Depositers' Society, London, June, 1931.

The composition of the solution now used for rapid plating is as follows:

Single Nickel Sulfate,	400-500 gm/litre	53-67 oz/gal.
(Nickel Metal Content)		12-15 oz/gal.
Nickel Chloride	22 gm/litre	3 oz/gal.
Boric Acid	22 gm/litre	3 oz/gal.
Nickel Nitrate 20% solution, about	1 cc/1	3-4 cc/gal.

The solution temperature is 45°-55° C. (113°-131° F.) and the current density ranges from 75 to 110 amperes per sq. ft. The pH range is from 4.8 to 5.7.

Solutions are continually agitated with a strong current of air and are filtered frequently or continuously.

Pitting is avoided by the continual addition of an oxidizer in small amounts, preferably nickel nitrate solution. However, nitric acid, hydrogen peroxide, potassium permanganate may be used. An excess of oxidizer is to be guarded against because fragile and burned deposits are obtained, and a great excess will cause a rapid drop in current efficiency.

A current density of 93 amps. per sq. ft. will deposit 0.001" of nickel in less than 15 minutes. This is at a cathode efficiency of 90-95%.

The pH control is by simple colorimetric tests. There are no exact calculations of throwing power, but in general the throwing power falls off as the current density increases. Parts are covered satisfactorily, however. Spring contacts are used on small parts.

Electrocleaning and acid dips are customary as in the U. S. More use is made of vapor degreasing, however. In France the tendency is to use heavy deposits of nickel direct on steel in place of complex deposits of copper and nickel. In such cases of direct nickeling, the steel parts are degreased and then given an anodic pickling before plating in 53° Bé. sulfuric acid for 10-30 sec. with a current density of about 150 amperes per sq. ft. Such treatment results in great adherence of the nickel to the steel, and no peeling is met with in subsequent chromium plating.

A brief reference to a few French plating plants will be of interest.

Societe de Radiateurs Chausson

This is the largest plant of its kind in France. Brass and steel radiator shells are plated, using automatic and semi-automatic equipment. Following customary cleaning and copperplating operations, the shells are nickelplated in a high nickel content solution at 50° C. temperature and with a current density of 45 amps. per sq. ft. for a 20-minute period. At 95% cathode efficiency the thickness of the nickel deposit is about 0.0008".

Automobiles Chenard et Walcker

Parts for 35 complete cars are plated daily. Steel parts are given the anodic pickle described above, before nickeling. Nickel is deposited directly on the steel in the above rapid nickel solution, using a current density of 80-90 amps. per sq. ft. for 15 minutes. This results in a deposit of 0.001", which represents a cathode efficiency of about 95%.

Etablissements Continsousa France

A large number of small parts of a varied nature are plated in a solution of a similar composition as mentioned above, at 90-100 amps. per sq. ft. current density. Steel parts are given an anodic pickle in sulfuric acid before plating. By the introduction of rapid plating baths the floor space and time of working have been greatly reduced.

Atelier, J. M. France

Rapid plating baths put 0.001" of nickel on bumpers.

Automobiles Renault, France

Automatic plating units are not used. Careful layout hand-operated rapid plating baths give an efficient plating process. Use is made of vapor degreasing in trichlorethylene and of anodic cleaning of steel bumpers before direct nickeling. This consists of an anodic pickle for 15 seconds in 53° Bé. sulfuric acid at a current density of 100 amps. per sq. ft. followed by a 15-30 second reversal of current. A plating current of 100 amps. per sq. ft. is used for six minutes at 50° C.

The solution composition is very similar to that cited by Ballay, with a slightly higher chloride content and with a pH range of 4.9-5.3.

After an acid copperplating for six minutes at 50 amps. per sq. ft., the parts are again electropickled and nickelplated for 12 minutes. A capacity of 2,000 bumpers per 8-hour day is available.

Automobile Citroen

A proprietary nickelplating solution in a semi-automatic machine is used. Parts are plated at 25-30 amps. per sq. ft. at 50° C. and with an unusually high pH value of 6.8-7.

English Practice

We are indebted to Mr. N. R. Laban for most of our information on modern English practice of rapid nickelplating. A series of articles in the Metal Industry (London) during June and July, 1930, is abstracted below. We regret that references to specific plants are lacking.

The bath composition recommended for a current density of 70 amps. per sq. ft. (or over) is as follows:

Density, 15°-17° Bé. . Temperature, 140° F.
Single nickel salts, 2.5 lb./gal. (Equivalent to 8.4 oz./gal. of metallic nickel.)
Nickel chloride or sodium chloride, value not given.
Boric acid, 3 oz./gal.
Useful pH range, 5.0-6.0

Mr. Laban uses the terms "low," "medium" and "high" to classify his current density ranges, and recommends an increase in temperature and nickel salt content to match an increase in current density. This is shown in the following table:

Current Density	*Temperature*	*Single Nickel Salts*
Low: 25 Amp./sq. ft. or below	25-35° C.=77-95° F.	1.5 lb. per gal.
Medium: 25-50 Amp.	35-50° C.=95-122° F.	1.5 lb.-1.8 lb./gal.
High: Above 50-70 Amp.	Above 50°=above 122° F.	1.8-2.5 lb./gal.
Above 70 Amp.	60° C. =140° F.	2.5 lb./gal.

NOTE: In general, the best results are obtained with the highest possible current density combined with a high temperature.

TANK CONDITIONS

Vigorous air agitation is used with constant filtration and anodes are bagged. To exceed 70 amps. per sq. ft. a moving cathode is essential. With 12 ft. per min. lineal cathode speed, as high as 100 amps. per sq. ft. may be used on many parts.

Separate motor-generator sets are recommended for each tank, with a 10-volt supply for current densities above 50 amps. per sq. ft.

The anodic cleaning of steel parts before nickelplating is customary. The electrolyte consists of strong sulfuric with 3 oz./gal. potassium bichromate.

THROWING POWER

As current density is increased, the throwing power falls off. This may be so serious as to limit the current density to 40 amps./sq. ft. for recessed parts.

Contacts must be given as much consideration as in chrome plating, and be of the spring contact type shaped as to avoid shading. A break in current at high current densities must be guarded against, to avoid a double deposit.

No trouble is met with in pitting as the tanks are lead lined, and organic matter is thus kept out. But little mention is made of current efficiencies or of plating speeds.

AMERICAN PRACTICE

As mentioned at the start of this paper, there is a division of opinion in the U. S. as to the ideal way to do rapid nickelplating. One procedure uses a pH value of 5 (electrometric) and an abnormally high nickel value. The other procedure uses a high acid value with a lower nickel content. The latter is the well known low pH solution for which Mr. Wm. Phillips of the General Motors Corp. is the best known champion.

HIGH NICKEL CONTENT SOLUTION

A solution of this nature is now successfully used at the Chevrolet Motor Car Co., Flint, Mich., for the plating of the tie-rods,

etc. Mr. A. B. Wilson, in charge of the installation, has been kind enough to give me the following tank data:

Single Nickel Sulfate, 60 oz./gal.
(Equivalent to 12 oz./gal. metallic nickel.)
Ammonium Chloride, 2.5-3 oz./gal.
pH 5.0 (electrometric)
Temperature, 140-150° F.
Current density, 75-125 amps./sq. ft., depending on the work.
Estimated plating speed, 0.001" and over, in ten minutes.

A difference of contacts and hangers with a full tank load of 15,000 amps. makes an exact determination of current efficiency difficult, but a reasonably high value is obtained.

Anodes are bagged, filtration is continuous and the conveyor runs at about 69" per minute. Throwing power is satisfactory.

Another large full automatic plant in operation in Michigan uses the following solution for automobile bumpers:

Single Nickel Salts, 48 oz./gal.
Nickel Chloride, 6 oz./gal.
(The above equivalent to about 10 oz./gal. metallic nickel.)
Boric Acid, 4 oz./gal.
pH, 5.0 (electrometric)
Temperature, 145° F.

Current density of 50 amperes per sq. ft. is used with the expectation of an increase to 75 amp. The solution was continually filtered.

High Acidity-Low pH Plating Solution

This is the solution with which Mr. Wm. Phillips has made us familiar. A brief summary of his conditions is given below:

Single Nickel Sulfate, 33 oz./gal.
(Equivalent to 7 oz./gal. of metallic nickel.)
Chlorides to give 2 oz./gal. of chloride radical.
Boric Acid, 3-4 oz./gal.
pH, 2.5 (electrometric)

Temperature, 150° F. Anodes are bagged and continual filtration is used. The usual current density is 20-40 amp./sq. ft. In some cases a current density of 90-100-amp./sq. ft. may be used.

The chief advantages claimed for such a high acidity solution are its range at high current densities, the clarity of solution, and the economy of operation, as the metal content is easily maintained

A Letter to all our Active Members

Dear Member Plater:

We are anxious to have the Educational sessions of the Philadelphia Convention the best ever. The educational meetings of the convention have been arranged in three divisions as follows:

TECHNICAL—DR. H. S. LUKENS, *Chairman*
Papers from Colleges and Technical Societies

INDUSTRIAL—DR. A. K. GRAHAM, *Chairman*
Papers from Industrial Chemical Plants and Associate Members

ACTIVE MEMBERS—S. T. LUNBECK, *Chairman*
Reports of the Research Committee, Educational Bureau, and Papers from our Active Members

In the past we have had more of the highly technical papers than we have had papers from the practical PLATER himself, so I am appealing to the PRACTICAL man to give us a paper, telling us in his own way just what he does to keep production up to the efficiency demanded today.

The everyday job which you are doing may seem simple to you, but your story may mean a lot towards the standardization of the "Common Practice" used in Electroplating, so let us have your story of how you keep your daily rejects to a minimum.

These papers should be forwarded to me by May 15 to be placed in the official programme of the convention.

Hoping and thanking you for your coöperation, I am,

Yours very truly,

S. T. LUNBECK, *Chairman,*
ACTIVE MEMBERS' PAPERS COMMITTEE,
3304 Washington St.,
Wilmington, Del.

by anode corrosion. The dragout is comparatively light. There is also reason to believe that a heavy nickel deposit from a high acidity solution will not only be smoother, but will afford better protection in salt-laden atmospheres than a deposit of equal thickness produced in the usual pH range of 5.0-5.7.

In concluding let me hope that the above comments have brought out some points of interest to my audience, and will serve as a basis for open discussion.

The Michigan chapter of the Electrochemical Society sent our Branch an invitation to attend their meeting on February 10th. It was accepted and a vote of thanks was given them for the courtesy extended to us. The subject at their meeting will be "Electrorefining vs. Electroplating." Two of our members, Mr. Eldridge and Mr. Soderberg, who is secretary of the Michigan chapter, are on the program and Detroit Branch will show its appreciation in good numbers.

Mr. B. F. Lewis, the able chairman of our Committee on Education, presided over the discussion following Mr. Eldridge's paper and the Question Box period. Mr. Lewis also told us something about "degreasing," a method of cleaning much used in Europe, and that seems to be attracting more attention here as it becomes better known.

The following questions were found in the Question Box:

Question—Is it possible to replace all of the sodium cyanide in a cyanide copper solution with Rochelle Salt?

Answer—Without the cyanide the anode efficiency is low and the bath becomes depleted of metal.

Question—What is the compound formed by copper and Rochelle Salt?

Answer—Copper tartrate.

Question—What is the best way of curing pitting in low pH nickel solution (pH about 1.6)?

Answer—If hydrogen peroxide fails to produce results, excessive copper and iron may be present in the bath. Copper may be removed by immersion deposition on clean steel sheets, after which the iron is oxidized and precipitated by raising the pH with nickel carbonate, and filtering.

Question—What preservative is used in commercial Perhydrol?

Answer—Acetanilid.

Question—When a radiator shell is nickelplated with a very heavy deposit of nickel and it gets scratched through to the base metal, is it necessary to strip the nickel before refinishing?

Answer—Experience has shown that the safest way is to strip the nickel. It is possible however to replate copper over the nickel if it is first cleaned and "struck" in the sulphuric acid strip for a few seconds to provide an "active" surface for replating.

Question—Is a 100% saponifiable grease stick essential to use on steel preparatory to copperplating with a cyanide solution?

Answer—Successful cleaning of oil polished steel for copperplating does not depend very much on saponification of the grease, as electric cleaning

will remove both saponifiable and unsaponifiable greases. However, since there is dirt other than greases to be removed, either scrubbing must be resorted to, or the use of a solvent cleaning system which includes spray-washing.

MILWAUKEE BRANCH

The regular meeting of Milwaukee Branch was held on February 11, 1932, at Lipps Hall, N. Third and W. Highland. The meeting was called to order by President M. Nishwitz, all officers being present. President Nishwitz appointed a committee to work with the Board of Managers to take charge of the arrangements and set the date for the Annual Educational Session and Smoker. The committee in charge is Board of Managers, Robt. Steuernagel, Jack Geissman, Ed. Werner and Dan Wittig, Henry Binder and Art Koehler.

One of our members gave the boys a formula for a nickel solution. He has tried it for several months with much success. It consists of 3 oz. single nickel salt, 1 oz. sodium chloride, 1 oz. ammonium chloride, 1 oz. boric acid, ½ oz. nickel fluoride, 1 gal. water.

Question—What is a good lubricant for burnishing die casting?

Answer—1 lb. of cyanide, 12 oz. of Ivory Soap Flakes. Make into soft-soap or use Peruvian Soap Bark.

Question—What is the proper per cent of cadmium to use in a nickel solution for a brightener, in any form?

Answer—No definite amount, use judgment, but be very careful.

The Librarian had a treat for the boys, a paper on Low pH Deposition of Nickel.

FRANK J. MARX, *Secretary-Treasurer.*

LOW pH DEPOSITION OF NICKEL

The deposition of nickel at low pH is comparatively a new condition in nickelplating. As long ago as October, 1932, the Bureau of Standards gave out a circular with respect to pH values for nickelplating. Dr. Blum by his intensive diligence tried at this time to interest electroplaters in the more exacting care of pH values, and tried to show that a variation of 0.1 pH was serious, and yet the equipment most platers use today will not read within such a change as 0.1 pH.

The use of higher acidity as a commercial scale has been used about three years, and was really developed by accident. At one of the Detroit plants the colorimetric system of reading pH was used, but brom cresol purple was the indicator and this will not show a value below 5.2. However, this plant kept adding $H_2 SO_4$ acid and their plating was improving. Finally this plant got a quinhydrone cell, and discovered that the pH was actually 2.1. The plating was of good quality, and we can really thank an accident for the information relative to low pH.

For the past two years we have been operating all our nickel baths with a low pH. Our reason for changing to this higher acidity was due to the fact that other manufacturers in our line were operating in this manner and had excellent results, and from other available information this type of bath should be so much easier to operate and keep in a good operable condition.

This type of bath has both advantages and disadvantages.

ADVANTAGES

1. Higher C.D. permissible, shortening plating time, and no curling and peeling of plate.
2. Softer plate, therefore easier to buff.
3. Better anode corrosion.
4. Solution is cleaner, no particles suspended in bath, all sludge goes to the bottom.
5. Saving in Nickel Salt, as anodes corrode rapidly enough to keep up metal content.
6. Solution will take care of itself for a longer period, once the pH is at the correct value for the type of work in hand.
7. Filter less frequently.

DISADVANTAGES

1. Anodes corrode too rapidly under some operating conditions.
2. Apparent greater *initial* tendency to pit.
3. Cathode efficiency is lower.
4. pH value must be kept below a certain value.
5. Tank construction must be better as higher temperatures are used.
6. In bright plating practice the low pH bath operates better at low temperature, while the high pH has a wider range.
7. Cannot plate zinc or die castings.

With regard to higher C.D., we have all encountered curling and peeling, especially in irregular shaped articles. With a low pH this is eliminated entirely. The older theory was that by adding acid, a hard plate resulted, and I will agree, but add more acid beyond a critical point, pH 4.8, and the plate becomes ductile, pliable and will flow more readily under a buff.

Since we have used the low pH, we have not had occasion to add any Nickel Salts. Even our tremendous dragout is replenished

from the anodes. Nickel in nickel anodes, while expensive, is cheaper than nickel in Nickel SO_4.

The critical pH for durability in a nickel bath is around 3 pH, and under this the solution is clear, even when under hard and constant use.

There are a good many reasons for a nickel bath to cause pitting, but I am convinced that the addition of H_2 SO_4 will cause pitting. At the present time there are a group of men studying pitting, they have been for two years, and they have not come to any conclusions as yet. Apparently dirt, hydrogen bubbles, iron, etc., cause pitting, but this study group has added these ingredients to nickel baths, and they could not say that the substance was the cause of pitting.

In a bath of low pH this value continually tends to rise, but it is not necessary to hold those values as near one point as with the high pH. A change of 0.2 is considered a good deal in high pH, while with the high acidity a change of 1.0 pH is easily within operating limits.

ST. LOUIS BRANCH

Regular meeting of St. Louis Branch A. E. S. was called to order by President R. C. Kells, February 12. The rollcall of officers showed two absent. There were no minutes read. Letter was read from Chairman Albert Hirsch of the Bureau of Education in regard to the work of the Education Branch, enclosing copy of chemical analysis, which will be turned over to Dr. Stout, St. Louis Branch Chemical Instructor.

Mr. H. H. Williams was appointed as representative for St. Louis Branch on the Bureau of Education. Mr. John Vogt of 9503 West Main Street, Belleville, Ill., was elected to membership.

On report of committees, Mr. Musich asked for a little further time for our get-together party.

St. Louis Branch was very sorry to learn of the death of one of our faithful members, Mr. George Lamkemeyer, who will be missed by all, and our heartfelt sympathy is extended to the members of his family.

There being no further business, meeting was turned over to librarian.

One question asked: In copperplating on tinplated parts what causes blisters?

Some said trying to plate too fast, others said too much free cyanide, and not properly cleaned. Another question: What are the advantages of using sodium cyanide or potassium cyanide in silver solution?

Answer: Could not see any as they got good results with both.

The meeting was well attended, 12 being present with visitors. Meeting adjourned at 10:00 P.M.

C. T. McGINLEY, *Secretary.*

ROCHESTER BRANCH

On February 7 about 40 members and friends of Rochester Branch gathered at the Forester's Hall on Webster Avenue and enjoyed a bowling party and buffet lunch. All seemed to have had a very enjoyable time. It was like old times, as Rochester Branch has not had any social affairs this winter.

The members of Rochester Branch meet every week on Wednesday evening for the chemical class. They have their own laboratory and have a very good instructor in Mr. G. A. Lux. The school is open to any member of Rochester Branch or any member of our society who is in this vicinity on any Wednesday evening. The school is located in the building at No. 7 Prospect Street.

On Friday evening, February 20, Rochester held their monthly meeting with a good attendance and President Hart in the chair.

A report of the past convention was read and it was turned over to the Board of Managers for their approval. Rochester Branch has been slow with this report but all's well that ends O.K. There was a general discussion of the conditions of the plating industry in western New York. Many of our members would like to help out in the research work but are unable to do so on account of business conditions. Many of our old members are out of work, the others have had wages cut and are also working on short hours. We hope business will pick up soon. We were very sorry to hear the secretary read the resignation of Mr. Adolph Newbeck of Buffalo, one of our members who has been a very good member of Rochester branch. We miss members like Mr. Newbeck.

We had the application of Mr. William Seibert of Elmira, N. Y., which was given to the Board of Managers for their approval.

We had a discussion in regard to our Annual Educational Session and Banquet. This was to be held open to our next regular meeting. Adjourned at 10:30 P.M.

CHAS. GRIFFIN, *Secretary*.

WATERBURY BRANCH

Philip Sievering, Supreme President, addressed the members of Waterbury Branch, at their February meeting. Taking for his subject the work of the Research Committee, past and contemplated, an interesting account was given of the most important projects sponsored by this body since its inception. The close relationship in the working out of plating problems that existed between the committee and the Bureau of Standards and the American Society for testing materials, was also touched on. Special stress was laid on the necessity of securing funds, in order to continue the work the committee had in mind. In compliance with the request made at the last convention that every member of the society contribute $2.00 to the funds of the Research Committee, Waterbury Branch voted $80.00 as its quota of this request. Past president Wm. Gray, who presided at the meeting, gave an interesting account of the several chemistry classes that were formed during the career of the branch. Several problems were presented and an instructive half hour ensued from the discussion of same. The semi-annual

report of the supreme secretary was received and read. Supreme President Sievering extended an invitation to all present to attend the annual banquet of Newark Branch. The entertainment committee reported that all business would be suspended at the March 11th meeting and that "fun and frolic" would reign supreme. WM. F. GUILFOILE, *Secretary.*

ANDERSON BRANCH

The meeting was called to order at 8:00 P.M., February 1, 1932, with 26 members and guests present. Rollcall of officers showed Messrs. Sanders, Phelps and Onksen absent.

Minutes of the January meeting were read and approved. Communications from Mr. Fraine, Mr. Gilbertson and the Chicago branch, were read.

Announcement was made of receipt of the Branch's copy of the elementary course in Analysis of Plating Solutions which is being published by the Bureau of Education.

Mr. Cleaver then introduced the speaker of the evening, Mr. Ralph E. Pettit, sales engineer for Aluminum Colors, Incorporated, of Indianapolis, who delivered a most interesting talk on the Alumilite Process. Discussion was invited and many interesting points were developed. An abstract of Mr. Pettit's talk is attached hereto.

The meeting adjourned at 10:00 P.M.

R. M. WAGNER, *Secretary-Treasurer.*

HARTFORD-CONNECTICUT VALLEY BRANCH

The Hartford-Connecticut Valley Branch held its regular monthly meeting on Monday evening, January 25, 1932, at the Hartford Chamber of Commerce.

The meeting was called to order at 8:30 P.M. with President Fleming in the chair. Minutes of the previous meeting were read and accepted. One letter was read and placed on file. No bills were presented. It was voted to subscribe the sum of fifty dollars ($50.00) to the research fund.

Mr. David A. Nemser, chief metallurgist of the Pratt & Whitney Aircraft Co., of Hartford, was then introduced and gave a very interesting talk on "Stainless Steels" which aroused much comment and discussion, which lasted over an hour. In conclusion he was given a rising vote of thanks.

The meeting was attended by fourteen visitors and members and was adjourned at 10:40 P.M. V. E. GRANT, *Secretary.*

CHICAGO BRANCH

The regular monthly meeting of the Chicago Branch was held February 14, 1932, at the Atlantic Hotel. The meeting was called to order with President J. C. Kretschmer presiding and all officers present.

Reports were heard from the Chairman of the Banquet Committee, who reported that we expect this to be one of the largest banquets ever held. The librarian reported that the papers to be presented will be of a high grade and should be very interesting.

Mr. Gus Jelinek, of the Edison Electric Appliance Company, read a paper

entitled, "Polishing and Finishing Chrome Steel." Mr. Jelinek answered many questions which were interesting and was given a rising vote of thanks. This paper will be published in the REVIEW.

The business part of the meeting having been taken care of, the meeting was turned over to the librarian, Mr. O. E. Servis, and the following questions were found in the Box:

Question—Is it necessary to use more zinc in a brass solution when plating cast iron, than when plating other metals, cast iron plated has not a good color?

Answer—Raise metal content.

Question—Installing an electric cleaner, should the tank be connected or should separate steel anodes be used? Should the steel anodes be nickel-plated?

Answer—Most members prefer nickelplated anodes, they will last six or eight months.

Question—How can stainless iron stampings be cleaned for nickelplating to withstand burnishing?

Answer—There will be a paper read at our banquet, "Plating of Stainless Steel," by Mr. Joseph H. Hoefer.

Question—Can cyanide in any form exist in a nickel bath at a temperature of 125°F. a pH 5.0? If so what is the result?

Answer—Cyanide will cause bright deposit. Would find traces of cyanide salt at given temperature. Members advised to make up new solution.

Question—What can be used to filter a cyanide solution that has free caustic soda in it?

Answer—Use number 8 cotton duck canvas for filter bag.

Question—What method other than measuring with micrometer can be used to determine thickness of deposits?

Answer—One member suggested salt spray method best for nickelplated work.

E. G. STENBERG, *Secretary.*

LOS ANGELES BRANCH

The regular monthly meeting of this branch was held on January 13, 1932, on the ninth floor of the Chamber of Commerce Building. The meeting was called to order by President E. W. Francis, all officers being present, with forty-one in attendance.

The minutes and communications were read and all bills were ordered paid and filed.

The Educational Session and Banquet to be held on Saturday, March 12, was finally decided, after which Mr. Benjamin Foss was appointed chairman of a picked committee with instructions to make final arrangements for the affair. Before the meeting adjourned there were 96 tickets pledged by those present.

President Francis was elected custodian of the six comparator and titrating sets loaned the branch by C. Kocour of Chicago.

Mr. E. Lamoureux of Chicago was with us again, but this time to stay. Mr. Lamoureux arrived in Los Angeles just in time to go sled-riding on the

first snow that fell here in a lifetime, being fifty years since the previous snow fell in this vicinity.

Mr. Sorensen of the Turco Products, Inc., gave a blackboard illustration of the pH control of a cleaning solution, followed by a talk on "The Relation of Cleaning Materials to Plating."

The meeting adjourned at 11:00 P.M.

M. D. RYNKOFS, *Secretary.*

BOSTON BRANCH

Thursday evening, February 11, an appreciative audience consisting of the Boston Branch and about forty guests listened intently while Mr. Oliver J. Sizelove of "The Metal Industry" answered their practical questions on present day plating problems. From the time the speaker was introduced by President Gale until the last question was answered, interest was maintained at a high level.

Judging from the trend of the questions there is an extensive increase in the use of zinc die-castings which require plating. The questions covered methods of cleaning, pickling and plating this class of alloy. Valuable information was given by Mr. Sizelove.

After all questions had been discussed the speaker read and explained typical letters from platers in all parts of the country. These letters requested analysis and advice on proper treatment of the solution which had been giving trouble.

The Branch was singularly honored by the unexpected presence of Mr. Sievering, Supreme President, whose speech was greeted enthusiastically.

Mr. Marshall, President of Worcester Branch, brought best wishes from the Heart of the Commonwealth.

The N. Y., N. H., & H. R. R. transported Dr. Strachan from the land of Roger Williams where King Philip caused some unpleasantness for the settlers a few hundred years ago. The Indians don't give any trouble any more in this territory but plating solutions do. However, you can't make a good plating solution by shooting it, which is the way King Philip was treated by his white contemporaries, so Dr. Strachan clearly outlined the value of coöperation between plater and chemist and vice versa.

Mr. Taylor of Boston Nickel Plating Co., and as far as we know the oldest man in this country actively engaged in the plating business, forgot about mashie, niblicks, etc., for a few hours and listened in on "putting out" nickelplating. Mr. Taylor played nine holes two weeks ago just a few miles from Boston and liked it.

Members from New Hampshire considered the time well spent. In fact every one who attended is agitating for more and better meetings along the lines followed in this evening's all-important discussion of the science of electroplating.

During the hour allotted to diminishing Boston's visible food supply, music was furnished intermittently by Mitchell Bros. Orchestra, artists of song and rhythm.

Socially and from the practical view the evening was a pronounced success.

A. W. GARRETT, *Secretary.*

NEWARK BRANCH

On January 15, 1932, the Newark Branch had the pleasure of listening to one of Newark Branch's members, Mr. George Hogaboom, in a talk on black nickel which was attended by 56 members. This talk was indeed interesting throughout and Mr. Hogaboom surely gave the members something to carry away with them, describing the origin of black nickel and the various formulas up to the present day.

On February 5, 1932, the Newark Branch had the honor of hearing Dr. L. C. Pew of the City College of New York.

Dr. Pew's subject for the evening was, "Metal Coloring," describing the different forms of metal coloring. The carbonates, sulphides, chrene, immersion and other forms of metal coloring giving formulas and describing each. The New York Branch attended and swelled the attendance to 66.

On February 19, 1932, Newark Branch had the pleasure of hearing Dr. Sanigar of Philadelphia give a talk on, "The Electrolytic Method of Finding the pH of Acid Solutions," describing the definition of pH and what pH stands for. The electrolytic method is indeed the most accurate seen so far by the members of Newark Branch. Dr. Sanigar's talk was most enlightening, starting from what is pH to an actual determination of a buffer and nickel solution.

On Friday, March 4, 1932, Newark Branch will have Dr. R. Mitchell, who will speak on "The Meaning and Application of Overvoltage."

On March 18, 1932, Mr. David Clarin will be in charge of Newark Branch's "Moving Picture Night."

On April 1, 1932, meeting of the Good Fellow Social Club. All welcome.

On April 15, 1932, Mr. Lewis Graham, subject: "The Electrical Side of Plating." May 6, 1932, Dr. William Blum, "Chromium Plating." May 20, Mr. Paul Oldan, Newark Branch.

CLEVELAND BRANCH

The monthly meeting of the Cleveland Branch was held on Saturday evening, February 6, at Hotel Winton, President E. Steen Thompson presiding.

The minutes of the January meeting were approved as read. A letter and report from Secretary H. A. Gilbertson was read. A letter from The American Brass Co., regarding the showing of their film "From Mine to Consumer," was read. A motion was carried that the Branch accept the offer and have the film at our next meeting.

Mr. Zadowski, chairman of the chemistry class committee, gave a report on the progress the class is making. After a general discussion of plating problems a motion to adjourn was carried at 10:30 P.M.

PAUL STAMM, *Secretary.*

A. E. S. CONVENTION

June 20-23, 1932 **Philadelphia, Pa.**

APPLICATIONS

GAIL ELDRIDGE, 5337 Central Ave., Indianapolis, Indiana (Assoc.) Anderson
JACK BRYDEN, 1253 Roscoe St., Chicago, Illinois.....Chicago
B. R. BOYD, 3-127 General Motors' Bldg., Detroit, Michigan (Assoc.) Detroit
GEO. L. NANKERVIS, 2-213 General Motors' Bldg., Detroit (Assoc.) Detroit
JOS. N. BOURC, Park Chemical Company, Detroit, Michigan (Assoc.) Detroit
JACK WISEMAN, General Delivery, Wyoming Park, Michigan, Grand Rapids
JOHN VOGT, 9503 W. Main St., Belleville, Illinois.....St. Louis
JOSEPH W. J. MEYERS, 3536 West 59th St., Chicago, Ill.....Chicago
SAMUEL DE JACK, 4333 N. Drake, Chicago Ill.....Chicago
WM. SEIBERT, American La France Foamite Co., Elmira, N. Y.....Chicago

ELECTIONS

GAIL ELDRIDGE, 5337 Central Ave., Indianapolis, Indiana (Assoc.) Anderson
B. R. BOYD, 3-127 General Motors' Bldg., Detroit, Michigan (Assoc.) Detroit
GEO. L. NANKERVIS, 2-213 General Motors' Bldg., Detroit (Assoc.) Detroit
JOS. N. BOURC, Park Chemical Company, Detroit, Michigan (Assoc.) Detroit
JACK WISEMAN, General Delivery, Wyoming Park, Michigan, Grand Rapids
JOHN VOGT, 9503 W. Main St., Belleville, Illinois.....St. Louis
JACK BRYDEN, 1253 Roscoe St., Chicago, Ill.....Chicago

SUSPENSIONS

J. KAMRATH, 6231 S. Winchester Ave., Chicago, Illinois.....Chicago
IRVING BOCK, 320 E. Colfax Ave., Chicago, Illinois.....Chicago
P. J. HARSCH, 224 High Ave., Cleveland, Ohio.....Cleveland
G. A. HANE, 7136 Cottage St., Philadelphia, Pa. .....Philadelphia

RESIGNATIONS

A. H. HOTHERSALL'S WOOLWICK, (SE 18) London, England.....from the Philadelphia Branch to take effect May 31, 1932.

TRANSFER

MR. WM. P. MANNING, active member of the New York Branch, transferred to Boston.

DEATHS

MR. C. WESSELL, 2115 E. 27th St., Los Angeles, California.....Chicago
MR. GEO. LAMKEMEYER, 4301-A Gano St., St. Louis, Mo.....St. Louis